

1. TITLE: The Astrometric Imaging Telescope Optical System
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6. ABSTRACT:

The Astrometric Imaging Telescope (AIT) is a planned space-based observatory designed to detect and study planetary systems and **circumstellar** material around hundreds of nearby stars. It contains two instruments that serially share the focal plane of the telescope. The **Ritchey-Chrétien** optical system has unique properties that allow the instruments to attain their **required** performances. The primary mirror has a 1.5 m diameter and 7.48 m focal length; while the system focal length is 22.6 m. The Optical Telescope Assembly and elements of the Attitude Control System and instruments, comprise the AIT optical system.

The first instrument, the **Circumstellar Imager**, directly images planets, disks, shells, and other bright material within 0.5-5 arcsec of bright stars. It employs a hybrid coronagraph, **internal** to the instrument, that reduces diffracted light from target stars by factors of 10,000 between 5-50 Airy rings. The coronagraph contains graded occulting masks, Lyot stops, and broad-band filters. The required performance has been demonstrated in the laboratory.

The main telescope optics are scatter-compensated in the mid-spatial frequency range to complement diffraction reduction in

the **Circumstellar Imager**. This reduces scattered light to the new diffracted light level in the region of interest. **Scatter-compensation** is a new method that results in the equivalent of a " **$\lambda/1000$** " surface in the central '10 arcsec of the focal plane image while the remainder of the image retains the scatter properties of a " **$\lambda/100$** " surface. Scatter-compensation also allows the optical system to be tested and calibrated as a complete unit.

The second instrument, the **Astrometric Imager**, performs **astrometric** measurements by centroiding images of target and reference stars on a focal plane **CCD**. The images are trailed on the CCD to allow '1000 centroid measurements that are averaged to yield better than 10 **μ arcsec** relative astrometric accuracy. The optical system is designed to ensure that the astrometric measurements are limited by photon noise and not by possible systematic errors. Therefore the telescope optics use a "**Korsch distortion-free**" design to mitigate the effects of the interaction between design distortion and unintended optical aberrations such as coma and astigmatism. These would arise because of permanent or variable in-flight decenters and tilts of the secondary mirror relative to the primary mirror. End-to-end modeling reveals that expected optical aberrations are well-handled by the method of data analysis. The optical design also mitigates the effect on astrometry of the interaction between inhomogeneous contamination on the optical surfaces and design distortion. Finally, modeling shows that existing manufacturing tolerances for optics are sufficient to ensure the required astrometric performance.

7. BRIEF BIOGRAPHY

Dr. Pravdo received his Ph. D. in 1976 from the University of Maryland. He worked as a Research Scientist at Goddard Space Flight Center in the X-ray Astronomy Group until 1979, and as a Senior Research Fellow at **Caltech** until 1981. From 1981 to the present he is a Member of the Technical Staff at the Jet Propulsion Laboratory. At JPL he was the Systems Engineer for the Shuttle Imaging Radar B and the AXAF CCD Imaging Spectrometer, and is presently the Program Manager for the Astrometric Imaging Telescope.